THE PREDICTION OF THREE YEAR DEVELOPMENTAL STATUS OF HIGH RISK INFANTS

BY

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W. June Holstrum

Dedicated to

Stacy, Shelly, and Shawn

whose patience and understanding

were indefatigable

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THE PREDICTION OF THREE YEAR DEVELOPMENTAL STATUS OF HIGH RISK INFANTS

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The purpose of this study was to describe the developmental status of three year olds who were placed in the Neonatal Intensive Care Unit (NICU) at birth. It was of interest to ascertain if those infants who were sick or premature at birth are equal to term infants in their development at age three. The study was also designed to investigate variables that contribute to the prediction of three year developmental status.

A multiphasic battery of tests was used to assess the developmental status of each child and the socioemotional environment in which she/he lives. The data were gathered to answer the following questions:

1) Do those infants who were sick and/or premature at birth catch up in their developmental status to term infants by three years of age?

2) Which of the variables under investigation contribute the most to the prediction of developmental status.

The study involved 102 three-year-olds born at or transferred to Shands Hospital, University of Florida. Half of the children had been placed in the NICU due to prematurity or illness. The other half were term infants placed in the Newborn Nursery

The children were evaluated with the Stanford Binet, the Carrow Test for Auditory Comprehension of Language and the Beery Developmental Test of Visual-Motor Integration. Demographic and socioenvironmental data were obtained through the Personal Interview, the Stressful Life Events checklist and the Behavioral Interview. Birthweight and amount of neonatal complications were obtained from medical records.

There were no statistically significant differences between the NICU and the term infants. These data do suggest, however, that the small infants are still small at three years of age and the infants who had the greatest amount of complications tended to have lower IQs and poorer scores on visual-motor integration. Birthweight, socioeconomic status and neonatal complications were found to be the most significant predictors of three-year developmental status. Material Resources (socioeconomic status) contributed significantly to the prediction of IQ and visual-motor integration. It was also found that mothers who experienced more stressful changes in their lives were more likely to perceive their children as having behavior problems.

Implications were discussed and suggestions made for future investigation and research.

CHAPTER I

INTRODUCTION

Each child comes into the world with a birthright--the right to receive the educational and psychosocial support that will optimize the development of the child. Frances Connor (1978) expressed it in these words: "Every child has a right to life with a caregiver who can facilitate the child's early development to the upper levels of the child's ability" (p. 25). In almost every state, the courts have recognized the right of an appropriate education for all children (Abeson, 1973). The federal government has also mandated education for special children. Public Law 94-142 guarantees the availability of special education to all children who need it (Torres, 1977). We, as professional educators are responsible for assisting in the task to meet this right of EVERY child. We are presented with an even greater challenge by the fact that certain children are born with unidentified strengths and severely handicapping limitations which put them at risk for developmental delay. Often these handicaps are the result of medical complications during the prenatal and perinatal periods. Equally as often, children are handicapped by socioenvironmental conditions which exist in the home--they are born into families which, for whatever reason, are unable to satisfactorily meet their needs.

Purpose of the Study

The purpose of this study was to describe the developmental status of three year olds who were placed in the Neonatal Intensive Care Unit (NICU) at birth. It was of interest to ascertain if those infants who were sick or premature at birth are equal to term infants in their development at age three. The study was also designed to investigate variables that contribute to the prediction of three year developmental status.

A multiphasic battery was used to assess the developmental outcome of three year olds. This battery included measures of the intellectual status, language comprehension, visual-motor integration, behavioral, and somatic development. These measures were used as the dependent variables. The independent variables investigated included infant measurements (birthweight, intrapartum factors, neonatal factors) and maternal measurements (mother's age, material resources, social environment and stressful life events).

Two groups of children born at or transferred to Shands Teaching Hospital, University of Florida,were a part of this study. One group consisted of three year old children who at birth were premature or had complications severe enough to be placed in the NICU. These infants were considered high risk for developmental delay. The second group of three year olds was used as a comparison group. These children were of term birth and had been placed in the Newborn Nursery (NBN). For this study the first group shall be referred to as the High Risk group, the second,as the Term group.

Context of the Study

Every child has certain universal needs. These include the physical accommodation of human function, an environment that is emotionally supportive and developmentally stimulating, and above all, nurturance by individuals who care. When a child's family is unable to meet these multifaceted needs, it becomes the responsibility of the professional community to join forces in a united effort to enhance the quality of life for each family and each individual. Thorough systems for the identification and prediction of development must be implemented for all children from the time of birth so that effective and encompassing intervention can be undertaken. If we are to become proficient as members of an interdisciplinary task force, it becomes necessary to more thoroughly explore the contributions of a number of factors related to the child's developmental and educational needs.

Relationship Between Neonatal Complications and Developmental Status

Children in the High Risk group of this study were placed in the NICU at birth due to prematurity or sickness. With the advent of the Regional Neonatal Intensive Care Centers during the 1970's, major changes in the care of premature and sick infants have occurred. Newborn care has been recognized as a subspecialty of pediatrics. Special equipment, such as respirators, and cardiac and respiratory monitors along with the specialized neonatal staff has dramatically increased the survival rate during the neonatal period of life (Francis-Williams and Davies, 1974; Teberg et al., 1977; Pape et al., 1978). Less clear is the effect of these changes on the developmental status of the survivors. Ross and Leavitt (1976) point out the need for improved assessment techniques to evaluate the effects of these changes on the survivors: "There is a clear and present need for reliable means of assessment of this population (NICU graduates) for the placement of persons in intervention programs, as well as the evaluation of the effectiveness of the programs themselves" (p. 111).

Placement in the NICU of sick and low birthweight infants results in a lack of early contact between mother and child. In the present study, the subjects in the High Risk group had an average NICU stay of 22.9 days. Research suggests that this lack of early contact may have detrimental effects on maternal/infant attachment, which in turn may affect the child's development (Rose et al., 1960; DeChateau and Wiberg, 1977; Klaus and Kennell, 1976; Ainsworth and Bell, 1970).

Predictors of Developmental Status

Prenatal and perinatal factors, infant tests, demographic variables, socioeconomic status and maternal attitudes are well acknowledged and documented in the literature as predictors of developmental status. Together these factors still do not account for the sum of the whole child's competencies, capabilities and limitations. Other possible sources of variance that we must begin to consider in our investigations are the social environment and the stressful life events faced by each family. No one type of assessment has been effective in identifying and/or predicting all disabilities. We can, though, begin to develop more reliable means of identifying high risk children who are in need of intervention. Through early recognition of developmental disability of the infant and young child, we can begin to better meet their needs by early implementation of intervention strategies designed to overcome their specific limitations.

Procedures for the prediction of delays come from many sources. All areas of physical, cognitive, language and socioemotional development must be taken into account in order to include and identify all possible delays. Prenatal and perinatal assessment has been effective in identifying disabilities such as: 1) Central Nervous System (CNS) dysfunctioning (Ross and Leavitt, 1976); 2) neurological difficulties (Parmalee et al., 1974); 3) perinatal complications (Lubchenco et al., 1964; Goldstein et al., 1976); and 4) early separation and attachment problems (Klaus and Kennell, 1976). The relationship between developmental outcome and socioeconomic status and parental attitudes are discussed by Wortis and Freedman (1965), Birch (1968), Rubin and Balow (1979), Beckwith (1971), McKeown (1971), and many others. A great deal of research has linked social environment and stressful life events to physcial and mental illness (Butterfield, Note 1; Dohrenwend, 1973), but few studies have related these factors to the child's developmental status.

Importance of Early Intervention to Developmental Outcome

Support and a rationale for early intervention comes from several sources: 1) a growing realization of the plasticity of the infants; 2) improvement in the procedures for predicting developmental retardation; 3) advances in perinatal medicine; and 4) the success of experimental intervention programs. Accompanying advanced strides in developmental and educational intervention strategies has been a heightened level of scientific knowledge, technology and clinical practice with infants who are born with severely handicapping complications. Bloom (1964) stressed that the period from conception to four years of age is the time when environmental intervention will be the most effective. Solomons, Holden, and Denhoff (1963) pointed out that the first year of life is the most viable with respect to the remediation of physical or biological disabilities. An important component of an intervention program is providing professional assistance to help parents become more effective in identifying and meeting the needs of their children. Brazelton (1978) stated that "work with parents is necessary and valuable if one wants to provide the most optimal environment for an atypical child . . . the home environment is the best source of encouragement and learning in a child's development. Most parents do need and can utilize the encouragement of a supportive single professional or team of professionals" (p. 15).

The studies which have investigated the effects of early intervention have yielded conflicting results. In a review of longitudinal studies of the effects of early intervention programs, Bronfenbrenner (1974) came to the rather pessimistic conclusion that preschool intervention does not yield long-term gains. Later reviews have been much more encouraging concerning the long-term effects of intervention (Palmer, 1978; Goodson and Hess, 1978). There is, however, a consensus in the belief that the most effective programs include a strong parent education and/or involvement component. Meier (1978) summarizes this belief in the following statement:

> The evidence to date indicates that knowledgeable and skillfull parenting is the most effective and economical means for fostering the optimum development of the child. Active participation by family members is critical to the long-term success of any intervention program. Ideally, intervention begins in preparation for parenthood and in providing an adequate cultural milieu for nurturing of the newborn infant. (p.5).

Methodological Problems

Several methodological problems exist in the research relating to children who are high risk for developmental delays. Most of these studies have a low N. Rarely do they include a comparison group of randomly selected children who were term birth and without major medical complications. Although it is recognized that there are many factors that contribute to the child's development, most studies investigate only one or two. Another problem which exists is the use of a developmental quotient (DQ) or intelligence quotient (IQ) as the only outcome variable. This limitation is quite important in view of the multivariate nature of human growth and development and the multidisciplinary approach from which these children are studied.

Higgens (1977), in a summary of the assessment procedures mandated by PL 94-142, listed the following requirements: 1) assessment should be individualized; 2) assessment is a continuous process; 3) information comes from multiple sources; 4) assessments should be culturally and linguistically unbiased; and 5) assessments should be sensitive to the child's handicapping condition. The question arises as to how we as professionals, can anticipate problematic development in order to design protocols for early identification of developmental disabilities which are preventative rather than remediative in nature.

Questions Posed in the Study

There are two general questions for this study: 1) Do those infants who were small and/or sick at birth catch up in their developmental status to term infants?; and 2) Which of the variables under investigation contribute the most to the prediction of developmental status?

To answer the above questions, the following specific questions are posed:

1. Are the slopes of the regression lines for each dependent variable (IQ, language comprehension, visual-motor integration, and behavior) on each predictor variable (material resources, mother's age, stressful life events, social environment, birth weight, intrapartum factors, and neonatal factors) equal for the High Risk and the Term groups?
2. Are there any significant interactions between birth weight, and intrapartum factors, birth weight and material resources, and birth weight and neonatal factors?
3. Do infants who were NICU graduates differ significantly from term infants with respect to IQ, language comprehension, behavior, visual-motor integration or somatic measurements at age three?
4. Which of the independent variables (material resources, mother's age, stressful life events, social environment, birth weight, intrapartum factors, neonatal factors, and birth weight by neonatal factor interaction) have the strongest linear relationship with IQ, language comprehension, visual-motor integration and behavior when the other independent variables are partialed out?
5. Do IQ, language comprehension, visual-motor integration and somatic measurement (height, weight, and head

circumference) vary as a function of birth weight, neonatal factors, or birth weight by neonatal factor interaction?

6. When controlling for birth weight, intrapartum factors, and neonatal factors, do mother's age, material resources, social environment and/or stressful life events add to the prediction of IQ, language comprehension, visual-motor integration and behavior?

Question 1 helps answer the first general question by describing the nature of the relationships between developmental status and the independent variables for each of the two groups.

The intent of question 2 was to improve the prediction equation by adding any interaction term which may add to the prediction of developmental status.

Question 3 answers the first general question by testing for significant differences in developmental status between the two groups.

Question 4 helps answer the second general question by testing for the relative strength of the relationship for each independent variable with the dependent variables.

Question 5 relates to both general questions by asking if the degree of prematurity or complications helps to predict developmental status.

Question 6 helps answer the second general question by asking which variables in addition to birth condition contribute to the prediction of developmental status.

Definition of Terms for this Study

1. Morbidity--refers to any visual, auditory, neurological, mental or physical diability.
2. Intrapartum factors--are any complications during labor and delivery.
3. Neonatal factors--are any complications occuring during the neonatal period (the first 28 days of life).
4. Term infants--are infants born without complications and placed in the NBN.
5. Developmental status--is mental, somatic, and behavioral development.
6. Intellectual status--is defined by the deviation IQ scores from the *Stanford-Binet*.
7. Somatic status--included height, weight, and head circumference.
8. Language comprehension--is measured by the Carrow *Test for Auditory Comprehension*.
9. Material resources--includes yearly income, occupation, marital status, mother's education and housing.
10. Social Environment--includes the mother's support system, degree of social isolation, relationship with love partner, and attitude towards living condition.
11. Stressful life events--is a measure of the magnitude of undesirable changes in the mother's life.
12. Visual-motor integration--is defined by the score on the Beery Test.

Limitations of the Study

External validity is threatened by unavoidable problems in sampling. (we attempted
Although ~~an attempt was~~ made to contact all NICU graduates within the

age limitation, many were lost to follow-up. There exists no means of determining the status of those individuals. There was a similar problem with the comparison group, due to the fact that many families had left the study area in the three year period following birth of the child and were not locatable.

The combination of an unfamiliar setting and being required to interact with a stranger may in some cases have caused spurious test results. An attempt was made to overcome this problem by testing in a playroom setting allowing the children time for free play and to become acquainted with their surroundings before testing.

An additional limitation was timing. The battery was long and some children who were tested in the afternoon missed their nap and were more impatient and unwilling to cooperate than usual.

The language and visual-motor measures and all interviews were administered by examiners who were naive as to which group each child belonged. Only the examiner who gave the Stanford-Binet was aware of group membership.

The study may have been strengthened with the inclusion of a measure of mother/infant interaction during infancy as an additional predictor variable.

CHAPTER II

REVIEW OF THE RESEARCH

This study was designed to describe the three year developmental status of high risk infants. This chapter will review the research literature concerned with variables that have been associated with the prediction of developmental status. The specific areas of concern which will be discussed are: 1) developmental outcomes of premature infants; 2) intrapartum and neonatal factors associated with development; 3) problems associated with early mother/infant separation; and 4) additional predictors of developmental outcomes: a) mother's age; b) material resources; and c) social stress.

Developmental Outcome of Premature Infants

With the advent of the Neonatal Intensive Care Units (NICU) the mortality rate of sick and low birth weight infants has dramatically decreased (see Table 1). Thompson and Reynolds (1977) reported that the neonatal mortality rate in the United States has decreased 44 percent from 1964 to 1974. This decrease in the mortality rate raises the question of the quality of life for the surviving infant. Many of the studies found in medical research since 1970 have concluded that not only has the mortality rates for very low birthweight infants decreased but there is an improved prognosis for the surviving infants as well (see Table 2). Lubchenco et al., (1974) designed a study to validate the effectiveness of intensive

Table 1

Mortality Rates Before and After the Development of Regional NICU's

	Years		Neonatal Mortality Rate per 1000 Live Births		
Region	Before	After	Before	After	% Decrease
Minnesota	1970	1974	14.2	10.7	-25%
Wisconsin	1968	1974	14.9	8.7	-42%
Iowa	1970	1974	15.1	10.6	-30%
Nebraska	1970	1974	15.4	11.6	-25%
Arizona	1966	1973	17.3	10.3	-40%
Mississippi	1968	1972	24.4	18.2	-25%
New Jersey	1962-67	1969-71	13.1	10.0	-23%
Columbus, Ga. + 13 Surrounding Counties	1959-68	1971-72	20.8	15.0	-29%
Metropolitan Toronto, Canada	1961	1872	15.4	10.1	-34%

Thompson et al., 1977

Table 2

Survival and Morbidity Rate of LBW Infants

Source	Years Follow-up	Infants Born	Birth-weight	Survival Rate	Infants in Follow-up	% Normal	% Questionable	% Abnormal
Stewart (1977)	1966-1975	145	1000g	39(26%)	27	78%	15%	7%
Dweck (1973)	7/68-6/70	82	1100g	15(18%)	14	79%	7%	14%
Grassy (1976)	8/68-9/72	98	1000g	27(28%)	27	70.3%	7.4%	22.2%
Fortune (1977)	2/66-3/70	675	1500	169(25%)	154	88%	8.9%	2.9%
Rawlings (1971)	1966-1969	149	1500	72(48%)	68	86.7%	5.9%	7.4%
Teberg (1977)	1965-1970	---	1500	347	176	76%	10%	14%
BHAT (1978)	1974-1976	100	1000	23(23%)	16	75%	---	25%
Pape (1978)	1974	97	1001	46(47%)	43	33%	37%	30%
Alden (1972)	1965-1970	161	1000	20(12.4%)	---	60%* 45%**	30%* 20%**	10%* 35%**
Nagel (1977)	1976	43	1000g	11(23%)	11	27.2%	45.6%	27.2%

*(mental)
**(physical)

care nurseries. It was demonstrated that the smaller, sick infants cared for in the intensive care units did as well as infants from the regular nursery.

In a follow-up study of premature infants in London, Stewart et al., (1977) focused on the intellectual development of high risk infants. From 1966 to 1975, 148 infants weighing < 1000 grams were admitted to University College Hospital, London. Thirty-nine (36 percent) of these infants were long term survivors. The authors followed 27 of these infants and found that 21 (78 percent) had normal IQ's with a mean IQ of 94; 15 percent had minor handicaps which was "defined as a disability that does not, or is unlikely to prevent the child from going to a normal school, or to interfere sericusly with normal life" (p. 101). Another seven percent of the infants had major handicaps. Stewart concluded that with optimal care, the prognosis for these very low birth weight infants is improved.

In a similar follow-up, Dweck et al., (1973) studied 14 of the 15 (18 percent) survivors with birthweight < 1100 grams. Fourteen controls were selected with similar backgrounds. On assessments at 11-1/4 to 33-1/2 months after birth the low birth weight (LBW) group had a mean IQ of 100; the control group had a mean IQ of 101. Dweck concluded that although only 18 percent of the tiny babies survived, there is an improved prognosis for the surviving infants.

In another investigation of developmental outcomes, in Melbourne, Fortune and Kitchen (1977) found that 88.8 percent of the surviving infants of less than 1500 grams were normal; 8.9 percent had trivial malformations and 2.0 percent had significant or serious deficits. Fortune concluded that malformations in LBW infants are rare.

Rawlings et al. (1971) had similar results: 86.7 percent of the surviving infants weighing less than 1500 grams were normal physically and mentally; 5.9 percent had doubtful mental and normal physical development; 7.4 percent had abnormal physical or mental development. Grassy et al. (1976) followed 27 infants who weighed < 1000 at birth. Eight of these children had neurologic abnormalities. Approximately 70 percent were described as being completely normal.

Teberg et al. (1977) studied 176 infants discharged from Special Care Nurseries between 1965 and 1970. He found 76 percent normal, 10 percent suspect, and 14 percent abnormal. During the five year study the perinatal mortality rates fell 30 percent. Teberg concluded that the very low birth weight infants (< 1000 grams) were no longer at increased risk of handicap when compared with those in the 1000-1500 gram group.

Kelsey and Barrie-Blakley (1976) used nine measures to assess the effect of prematurity on language development for 45 four-year-olds. They found no significant difference between the low birth weight and the full term children. However, their subjects were all middle and upper class children and no very low birth weight children were included. Other researchers have not found such encouraging results. Rubin et al. (1973) studied 241 low birth weight infants to determine if prematurity is cause for children to be considered high risk for school difficulties. His sample was 96.5 percent white middle class. His finding suggested that low birth weight infants score lower "on measures of mental development, language development, school readiness and academic achievement from preschool through elementary school years" (p. 360).

In another study, 32 infants weighing less than 1251 grams at birth were evaluated at five years of age (Fitzhardinge and Ramey, 1973). The mean IQ for boys was 88 and 92 for girls. Only 10 children were defined as completely normal.

Resnick et al. (Note 2) reached the conclusion that the prognosis for low birthweight infants (1000-1500 grams) has improved. Approximately 87-95 percent are developing normally. However, those infants of very low birthweight (< 1000 grams) are still high risk for disabilities. Only 37-47 percent in this weight category are developing normally.

Saint-Anne Dargassies (1977) reported the results of a follow-up study involving 286 premature infants. It was found that 21 percent had severe neurological impairment. The smaller the infant the greater the degree of abnormality. She concluded that "premature infants are in fact rescued survivors: the risk to life and the risk to severe neurological sequelae are linked and both are dependent on the degree of prematurity" (p. 474).

In 1974, Pape et al. (1978) followed 43 infants of less than 1000 grams. His results were: 33 percent normal, 37 percent had minor neurological delay, and 30 percent had significant handicaps. Alden (1972) reported the following results: 60 percent normal mentally, 45 percent normal physically; 30 percent questionable mentally, 20 percent with minor neurological abnormalities; 20 percent retarded and 35 percent significant neurological abnormalities. Nagel et al. (Note 3) evaluated 11 survivors weighing less than 1000 grams. Twenty-seven point two percent were normal; 45.6 percent had minimal handicaps; and 27.2 percent had severe mental or physical handicaps.

Graham et al. (1976) examined 355 three-year-olds. He divided them into three groups: those who were full term normal newborns, those who were anoxic full term newborns and newborns with other complications. The anoxic group was found to be significantly less competent on neurological and cognitive measures. Prematures had significantly lower cognitive scores but were neurologically equal to the full term normals.

In a review of studies of the sequelae of prematurity Caputo and Mandell (1970) concluded that low birth weight infants continue to be at a disadvantage as they grow older. These authors listed the following consequences associated with prematurity: 1) lower IQ scores; 2) greater tendency toward deviant behavior; 3) delayed language development and poor reading ability; and 4) more physical and neurological dysfunctions.

The reason for the discrepancy of the sequelae of prematurity is not clear. More controlled studies are needed to determine if these differences are due to actual variance in outcome or if they reflect different methods of evaluation or differences in the particular populations sampled.

Intrapartum and Neonatal Factors Associated with Development

Numerous studies have focused on particular intrapartum and neonatal factors to predict later IQ or developmental status (Nelson et al., Note 4; Werner et al., 1968; Ramey et al., 1978). The comprehensive Collaborative Study, begun in 1957, was designed to establish a method for determining during pregnancy the risk of mental and neurological deficiencies in children (Berendes, 1966). The British Perinatal Mortality prospective study attempted to identify some of the causes leading to mortality and morbidity of infants (Butler and Alberman, 1969). Wigglesworth (1968) devised lists of risk factors for obstetricians and pediatricians to use for the identification and prevention of developmental disabilities in children. These studies have made important contributions to the early detection and prevention of handicapping conditions.

Smith, Flick, Ferriss and Sellman (1972) found that by using prenatal, perinatal and postnatal variables they could correctly assign children to normal or abnormal groups at age seven. The designation of normal or abnormal was obtained from a composite score representing a weighted sum of nine psychology test scores for each child. Each composite score was transformed into a z score. Normal was defined as: z score $\geq$ 1.00; abnormal was defined as: z scores $\leq$ -1.00. Subjects were 301 low SES Blacks. Prenatal and perinatal variables alone correctly classified 88.1 percent of the children. With the addition of data collected during the first year of life, 92.4 percent of the children were correctly classified as normal/abnormal at age seven. Data collected at three and four years of age correctly classified 98.4 percent. Although the percentages are impressive, the discriminant function analysis only divides children into two categories, which does not provide much differentiation of outcome.

Ramey et al. (1978) used information from birth certificates to predict success in school in order to provide easily accessible and inexpensive means of identification. They found that birth certificate information can be used to predict school success.

The most predictive variables were the child's birth order and birth weight, the education of mother, the month prenatal care began, race, and legitimacy.

In a study of 300 low birthweight infants,Drillien (1972) attempted to identify children who might have problems in school. He found that infants with abnormal neurologic signs during the first year of life were more likely to have mental and behavior problems at age three than were infants at the same birthweight who had little or no neurological abnormality. He concluded that infant neurological status does have prognostic significance.

Caputo et al. (1974) studied 233 low birthweight infants and found that the neonatal factors of birthweight, gestational age, birth length and head circumference were the best predictors of development at one year of age. Demographic factors also contributed significantly to the prediction of developmental status. These researchers concluded that neonatal factors, demographic factors and development are complexly interrelated.

Goldstein, Caputo and Taub (1976) attempted to predict outcome at one year of age using 35 prenatal and perinatal variables. A factor analysis of these variables resulted in seven major factors that were used in multiple regression analysis. These factors were successful in predicting 12 percent of the variance in DQ scores at one year. The variables accounting for most of the variance were delivery and related variables.

The relationship between events occuring in the prenatal, neonatal, and infancy period and later performance was investigated by Littman and Parmelee (1978). They concluded that prenatal and neonatal complications are often transient and do not significantly predict outcome. Medical complications occuring later in infancy have a much greater impact and have a stronger relationship to developmental outcome. The authors stress the importance of continued follow up and assessment in order to identify children with disabilities.

In summary, it appears that there is a relationship between intrapartum factors, neonatal factors and the young child's development. The strength of the relationship,however, is unclear. These factors do contribute to the prediction of outcome but cannot effectively be used in isolation.

Problems Associated with Early Mother/Infant Separation

The infants in the High Risk group of this study had an average stay in the NICU of 22.9 days. Therefore, it is important to review the research that discusses the implications of mother/infant separation during the neonatal period. Early research focused on how separation of mother and infant affected the infant. Beginning in the late 1960's researchers began to look at the effects of separation on the mother. The studies cited in this paper strongly suggest that early and prolonged separation interferes with the process of mother-infant bonding. Inadequate bonding results in disorders of maternal behavior which affects the child's developmental status.

Many researchers have studied the effects of early contact between the mother and her infant. These studies strongly suggest the existence of a critical or sensitive period immediately following birth which is optimal for the establishment of a mother/infant attachment bond. One of the earliest studies was done by Rose et al. (1960). These researchers followed up mothers whose infants suffered from RH incompatibility. They found that during the separation period these mothers developed negative attitudes towards their children. The mothers perceived their infants to be less able to maintain life. At the age of four and five this attitude appeared to "constitute a special handicap for nurturance and fostering of healthy child development" (p. 776). Rose et al. concluded that when separation occurs, the attachment bond can be easily disturbed and may be permanently altered during the first few hours of life.

DeChateau and Wibert (1977) examined the effect of 15-20 minutes of nude contact between mother and infant immediately after delivery. Subjects were divided into three groups: 1) 22 primiparas had the extra skin-to-skin contact; 2) 20 primiparas were given routine care; and 3) 20 multiparas were given routine care. (Routine care: mother sees the infant immediately after birth for quick glance but does not touch. After the baby is cleaned, weighed and dressed, it is brought back and put in a crib next to the mother or in the mother's bed.) At 36 hours the extra contact group of mothers had more close contact with their infants and the infants cried less. At three months of age the researchers made observations in the homes and administered an interview. The extra contact mothers spent more time en face and kissing. Their infants laughed or smiled more frequently. The other two groups spent more time in caretaking routines with their infants and these infants cried more. DeChateau and Wibert's study suggests that even 15 to 20 minutes of skin-to-skin contact during the first hour makes a difference in maternal behavior.

Hales et al. (1976) conducted a similar study in which the experimental group of 20 mothers lay skin-to-skin with their infants under a heat panel for 45 minutes immediately after birth. The other two groups were separated from their infants for the first 12 hours. Mothers in the contact group showed significantly more attachment behaviors, such as more time spent en face and kissing and a quicker response to their infant's cry. This study also suggests a sensitive period immediately after birth.

A study by Klaus et al. (1972) has the advantage of long range follow-up. In this study the early contact group of 14 mothers were given their babies nude for one hour immediately after birth and for five extra hours on each of the next three days of life. The control group of 14 mothers were shown their baby at birth but no contact until the infant was six to eight hours old. At 28-30 days after birth the early contact mothers were more reluctant to leave their infant with someone else. They showed more soothing behavior when their babies cried. They also spent more time en face and fondling during feeding.

In the five year follow-up of the Klaus (1972) study, Ringler et al. (1976) reported that the early contact children had higher IQ scores and they scored higher in word comprehension and ability to understand complex phrases. Ringler et al. conclude that the amount of contact in the hospital can significantly affect maternal behavior and consequently affect the language expression and comprehension of five year olds.

While the evidence of a critical period is impressive, not all researchers ascribe to this theory. Leiderman (1978) discounts the theory of the critical period for the establishment of the attachment bond. He states that the main value of this theory was to stimulate further research concerning mother/infant relations and child development. As a result of his research he concludes:

> Human beings are not so inflexible and unadaptive that the initiating and fixing of a social bond must be accomplished in a very brief period following birth. On the contrary, the human organism is sufficiently complex to insure redundancy in the activation of mother-infant attachment systems. Thus, if these systems are not activated at birth, in the normal course of events, they will surely be activited within the infant's first months of life. Becoming appropriately maternal is a process emerging long before birth and continuing long thereafter. (p. 71).

Several studies have considered the relationship between early neonatal separation due to premature birth or illness and child abuse (Green and Solnit, 1964; Elmer and Gregg, 1967; Klaus and Kennell, 1970; Klein and Stern, 1971; Fomufod et al., 1975; Lynch, 1975; Barnett et al., 1970). Although the issue of child abuse is beyond the scope of this paper, it is important to be aware of the possible ramifications of neonatal separation of the infant and mother. In all of the studies cited above a high correlation was found between child abuse and early and prolonged separation. In a review of the research, Klaus and Kennell (1970) determined that in 39 percent of all child abuse cases the infant had been premature or severely ill. Fomufod et al. (1975) agreed that "early and prolonged neonatal hospitalization may interfere with the development of natural maternal-infant bonding and set the scene for even greater distortions at a later date" (p. 550).

Additional Predictors of Developmental Outcomes

In recent years there have been numerous attempts to assess the relative contributions of medical, demographic, and socio-environmental factors to the prediction of the young child's development. Many researchers have also discussed the feasibility of predicting developmental status from the results of tests administered during infancy. Most of these researchers agree that infant tests as isolated entities cannot predict later development for all children but the tests are able to predict gross mental retardation (Vanderveer and Schweid, 1974; Birch, 1968; Holden, 1972; Welcher, Mellitis, and Hardy, 1971). Since no single variable has successfully predicted developmental status it becomes necessary to consider multiple variables that may contribute to the prediction of developmental status. Specifically, this study infestigates the additional contributions of: a) mother's age; b) material resources; and c) social stress.

Mother's Age

Prematurity has consistently been associated with mother's age. In reviewing the research concerning this association, Crider (1976) and McKendry et al. (1979) reported a strong relationship between prematurity and adolescent mothers, especially for mothers 14 years and younger. Since a significant number of premature infants are from adolescent mothers, it is important to investigate the relationship betweeen the age of the mother and the child's outcome.

Oppel and Royston (1971) compared the children of 86 adolescent mothers with children whose mothers were over 18. They concluded that children of younger mothers tend to have greater deficits in their physical, social and/or psychological development.

The main effect of mother's age on the child's development may be confounded by the amount of prenatal care. Dott and Fort (1976) suggested that young mothers seek less prenatal care.

In a longitudinal follow up study of children of adolescent mothers, Hardy et al. (1978) assessed the development of four-year-olds. Their results indicate that the children of young mothers have less adequate outcomes on measures of IQ, behavior, fine and gross motor development. Furstenberg and Crawford (1978) found that the extended family and the amount of emotional support an adolescent mother receives was associated with the outcome of their children. He concluded that developmental status is enhanced for children of adolescent parents by financial help and emotional support from the extended family.

Material Resources

Material resources includes mother's education, yearly income, occupation, marital status and housing. It is a measure of socioeconomic status. Efforts to predict intellectual development have been strengthened by considering the socioeconomic status of the child's family. Willerman and Broman (1970) studied the function of social class in predicting IQ scores at four years from Bayley Mental and Motor Scales at eight months ($n = 3037$). They found an interaction between social class and IQ at four years. For infants scoring high on the infant tests, SC was not related to IQ. For low scoring infants, there was a relationship. Retarded, low SC infants were seven times more likely to have IQ scores < 80 at four years of age than were retarded infants of higher social class. The results of this study suggest the vulnerability of children born into poverty. Not only are they at higher risk for neonatal insult but the poverty amplifies poor development.

Similar results were found by Rubin and Balow (1979). For the entire sample (n = 1,382) socioeconomic status (SES) was a better predictor of later IQ than were Bayley Scores at eight months. Low scores on the Bayley were predictive of low IQ for all SES groups. Infants with low SES and low Bayley scores were the most severely impaired for later development.

McKeown and Record (1971) investigated early influences on intellectual development. They were interested in the relative contributions of heredity and environment to the development. They concluded that prenatal environmental influences contributed little to the prediction of intelligence within the general population. There were significant differences in intellectual outcome between social classes but it was unclear as to whether this was due to heredity or environment. The fact that separated twins had higher scores than twins raised together suggest significant postnatal influences.

In a review of selected health factors influencing the prediction of intellectual functioning and learning, Birch (1968) concluded that "children who are economically and socially disadvantaged and in an ethnic group exposed to discrimination, are exposed to massively excessive risks for maldevelopment"(p. 95). Birch stated that early diagnosis and special education must be utilized in order to reduce learning handicaps.

Werner,Honzik and Smith (1960) conducted a study to investigate the variables that contributed to the prediction of ability and achievement at age 10. They found that a combination of the pediatrician's assessment and the score on an infant test was particularly useful in predicting later problems, especially for infants with low assessment. They also found that "low parental socioeconomic and educational status were characteristics of those children whose intelligence level declined from normal to borderline intelligence and educational retardation . . . .The combination of retarded development and a deprived environment in infancy is more predictive of serious achievement problems at school age than either infant or family variables alone" (p. 1074). These authors obtained a multiple correlation of .58 between outcome at 10 years and infant IQ when they combined pediatricians' assessments, infant test scores, and socioeconomic variables. For children whose infant scores were below 80, a correlation of .80 was obtained.

As part of the Collaborative Study, Ireton et al. (1970) explored the relationship between infant test scores (Bayley Mental Scale at 8 months), socioeconomic status (SES), infant neurological status and Binet IQ at four years of age. The subjects in this study were 536 full term four-year-olds. There appeared to be no significant relationship between SES and infant test scores, but SES was the strongest predictor of four year IQ.

Some researchers attribute the difference in outcome between normal full-term infants and infants born with complications to social status or parenting attitudes and skills. These factors have long been cited in the educational and psychological literature as contributors to the development of children in general. Hommers and Kendall (1976) states that "it appears that important predisposing factors to prematurity are adverse social circumstances, and . . . these adverse factors continue to operate following the birth of the infant" (p. 750). Francis-Williams and Davies (1974) noted that social class difference in IQ was marked. Learning difficulties were present in 1/5 of the children in their study, many of whom had normal IQs. The learning difficulties appeared to be a result of "disorderly mental development." The authors felt that early intervention would do much to facilitate the development of normal capacity for intelligence and learning.

Social Stress

Children are not raised in isolation. They are affected by the environmental conditions surrounding them. Specifically, they are affected by the socioemotional state of their primary care giver. To a large extent, this state is a reflection of the amount of social stress occuring in the care giver's life. Two measures of social stress were included in this study. The first measure of stress was labeled Social Environment. It was concerned with stressful living conditions such as the mother's support system, the amount of social isolation, relationship with lover partner, and general attitude toward the present living condition.

The second measure of stress was labeled Stressful Life Events. It was concerned with events which occured in the mother's life that had a detrimental effect such as loss of a loved one, sickness, serious accidents, or loss of income.

Few studies have considered the effect of these variables on the developmental status of the young child. A unique study now in progress in Denver was designed to evaluate the effect of maternal support systems and parent groups on parent child interaction and competence. Preliminary results indicate that the experimental group of adolescent parents are better able to cope with their situation and have better parental attitudes (Butterfield, Note 1).

Grossman (1979) investigated the contribution of prematurity and social stress to the prediction of mother/infant interaction and child development. He found that families with premature infants experienced more social stress both during the prenatal period and infancy. Social stress was also predictive of mother/infant interaction. Grossman concluded that "such linear relations between poverty-related stress measures and mother-infant relational items would seem to imply that perceived stressors such as interpersonal conflicts, impaired emotional state, stressful life events, and inadequate material and social supports mediate between poverty and development in some sort of mutually debilitating fashion" (p. 62).

Sameroff (1978) emphasized the need to consider environmental and socioeconomic variables when predicting the outcome of young children. He describes a "transactional" model of interaction in which he recognized the effect of the child on his environment. While his parents are shaping the lives of their children, they are also being shaped by their children. Sameroff suggested that in the research of child development, children ought to be thought of as living subjects not mechanical objects. If an infant is born with complications or imperfections, she/he should not be treated as if she/he were made with a defective part that will always be inferior.

Wortis and Freedman (1965) investigated the effects of social environment on premature children. They compared a group of premature, low income Black children with a group of low income Black children who were full term at birth. Their results indicated that children born prematurely may be more vulnerable to poor environmental conditions. Although physiological variables had more of an effect on the child's development at age two and a half, it was clear that social development was affected by the quality of maternal caregiving. It was suggested that social development would have an increasing effect on IQ as the child grew older.

Werner et al. (1968) studied the relative contributions of perinatal complications and the quality of the home environment to school success. Home environment included emotional support, educational stimulation and socioeconomic status. The group of children who suffered severe perinatal complication had more handicaps and lower IQ's. Children with moderate or mild perinatal complications were more affected by a deprived environment than by perinatal stress.

Life events are naturally occuring events which cause change in people's lives such as: birth, death, marriage, divorce. These changes require readjustment in established patterns of living and often produce stress as a consequence. Numerous studies have associated these events with physical and mental illnesses (Hinkle, 1974; Holmes and Rahe, 1967; Vinokur and Selzer, 1975; Myers, Lindenthal and Pepper, 1972; Dohrenwend and Dohrenwend, 1974). The amount of stressfull events occuring seem to be related to social class. Low SES individuals report more occurrances of unfavorable events than high SES (Caplovitz, 1963; and Hollingshead and Redlich, 1958). It seems reasonable to hypothesize that if undesirable life events can have detrimental effects on the mental and physical condition of individuals that this adverse sequelae would negatively affect the developmental status of children.

Myers et al. (1971; 1972; 1975) reported a significant relationship between the number of stressful events and psychiatric systems. They also noted that there were many individuals who did not fit the pattern; i.e., persons with a large number of events, but no psychiatric disorders and persons with severe psychiatric systems, but no events. The research of these authors indicated that the unaccounted for variance could be explained to a large extent by the "level of social integration." In this present study, social integration is included in the set of variables labeled as social environment.

Although at this point it would be difficult to draw any definite conclusions as to the combined predictability of infant tests, medical and environmental conditions, all of these factors seem important in predicting outcome and planning programs of remediation and intervention. While predictability is far from perfect, early diagnosis and assessment are prerequisites to intervention. Due to the imperfect predictability and to change in scores over time, repeated assessment is essential to check the effects of intervention and to provide direction for continued intervention.

This chapter has reviewed the research pertinent to the variable of interest in the present study. The next chapter will describe the questions to be investigated and the research design and methodology to answer those questions.

CHAPTER III

DESIGN OF THE STUDY

This research was designed to describe the developmental status of three year olds who were high risk infants. The effect of NICU treatment was examined by a comparison between term infants and infants who were in the NICU at birth due to prematurity or birth complications. This chapter explains the design, methodology, and statistical procedures used to investigate the questions posed in Chapter I.

Design

This is an ex post facto design to study three year olds with or without birth complications. A total of 102 three year olds was evaluated. Each mother, or primary caregiver, participated in the study by observing all testing procedures and responding to three questionnaires. A multiphasic test battery was used to assess the developmental status of the children. This battery included: 1) the Stanford Binet Intelligence Test (SBIQ); 2) the Test for Auditory Comprehension (TACL); 3) the Developmental Test for Visual-Motor Integration (VMI); and 4) the Behavioral Interview. These instruments measured the dependent variables of IQ, language comprehension, visual-motor integration and child's behavior, respectively. The additional dependent variable of somatic development was assessed by measurements of height, weight, and head circumference.

There were seven independent variables: 1) birthweight; 2) intrapartum factors; 3) neonatal factors; 4) mother's age; 5) material resources; 6) social environment; and 7) stressful life events. Measures of the first four variables were obtained from medical records. Scores for variables 5, 6, and 7 were obtained from interviews with the mother.

Instrumentation

Birth measurements, intrapartum and neonatal factors were obtained from medical records. Scores for intrapartum and neonatal factors were obtained by using Hobel et al. (1973) high risk screening system. Each complication was assigned a weighted value according to its assumed risk. The total score reflected the severity of intrapartum or neonatal complications (see Appendices A & B).

Material resources and social environment scores were obtained through the Personal Interview instrument (see Appendix C). This instrument was a modification of Kotelchuck's social stress interview referenced in Grossman (1979). Material resources is a composite score which includes mother's education, yearly income, occupation, marital status, and housing. Social environment is the second composite score determined from this interview. It is concerned with the mother's socioemotional status which includes her social support system, level of social isolation, relationship with love partner, and attitude towards present living condition. The interview was designed to provide a numerical score for each item. The higher the score, the more negative the situation.

Each mother was given the Stressful Life Events checklist. This was a modification of the Schedule of Recent Events developed by Holmes and Rahe (1967). The Holmes and Rahe instrument has been used extensively in stress research. This instrument contains 43 events which subjects rate as to the amount of readjustment each event requires without regard to the desirability or undesirability of the event. Komaroff et al. (1968) administered this instrument to Blacks and Mexican Americans to determine if the subculture groups rated the items significantly different from the white American group studied by Holmes and Rahe (1967). The results were that the correlation for the white Americans and the Blacks was .789; for white Americans and Mexican Americans was .735; and for Blacks and Mexican Americans was .735. They concluded that there were no significant differences in the way the three population groups rated the items. Vinokur and Selzer (1975) studied the relationship between life events and mental stress (n = 1959). They found that mental stress and undesirable life events had a correlation of .32. Mental stress and desirable life events correlated .09. They concluded that "only the undesirable events were substantially correlated with stress-related variables and that these events required greater adjustment than desirable ones" (p. 335). For this reason only the undesirable events were included in the present study. Some of the words were also simplified to make it more comprehensible to the subjects in this study. The final list contained 26 events which each mother rated on a four point scale ranging from not stressful to very stressful (see Appendix D).

The Stanford-Binet Intelligence Scale, Form L-M was used to assess the children's IQ. Reliability is a function of age and IQ level. For ages 2-1/2 to 5-1/2 the reliability coefficients range from .83 to .91 (see Appendix E).

Language comprehension was assessed by the Carrow TACL. The Southwest Educational Development Laboratory obtained the first reliability measure. A test-retest reliability coefficient of .94 was obtained with a sample of 51 Mexican-American and Anglo children (Carrow, 1973). In another study to estimate reliability, this instrument was given to middle and lower class Black and Anglo children. A reliability coefficient of .77 was obtained using the Kuder-Richardson Reliability Test (Jones, 1972). The TACL is a 101 item test in which the child was presented with three black and white pictures. A word clue was given and the child responded by pointing to the corresponding picture (see Appendix E).

Visual-motor integration was assessed by the Developmental Test of Visual-Motor Integration (VMI) developed by Beery (1967). Visual-motor behavior is a combination of visual perception and fine motor coordination. The VMI contains 24 geometric forms arranged in order of difficulty (see Appendix G). The test was designed to be used with children between the ages of two and fifteen years. A child continues copying the forms until she/he misses three in a row. None of the the three year olds in this study passed more than seven items. Beery states that the VMI correlates .89 with chronological age and that the correlation is higher with mental age.

A modification of the Behavioral Screening Questionnaire (BSQ),developed by Richman and Graham (1971), was given to each mother to determine how she perceived her child's behavior. The original questionnaire was designed to obtain information concerning development, health, and behavior of three year olds. For this study only the behavioral items were used. The behavioral items included sleeping and eating difficulties, activity level, attention span, fears, temperament, degree of independence, and relationships to peers and adults. Each item was scored on a three point rating scale (see Appendix H). Richmond and Graham successfully used this instrument to identify children with behavior problems. Using the same questionnaire, Coleman et al., (1977) reported a relationship between the mother's perception of the child's behavior and the amount of social stress. They concluded that "mother and pre-school child exist in an interacting system where disturbance or illness in the one in turn affects the other. A vicious circle is thus set up in which there is a greatly increased likelihood that both individuals will show signs of stress" (p. 207).

Subjects and Sampling

Two groups of subjects born between September 1975 and March 1976 were used for the study. The High Risk group consisted of 51 children between the ages of 36 and 42 months at the time of testing. These children are graduates of the Neonatal Intensive Care Unit (NICU) at Shands Teaching Hospital, University of Florida, Gainesville, Florida. The Shands NICU is one of nine centers in the state-wide Regional Neonatal Intensive Care (RNIC) follow-up evaluation program. These centers evaluate the medical and developmental status of premature and sick infants at 6, 12, 36 and 48 months of age.

The term group consisted of 51 term infants born at Shands who had reached the age of between 36 and 42 months at the time of testing. These children were selected by the technique of systematic random sampling (Borg & Gall, 1979). The total number of infants born at Shands during a given month was divided by the number of infants admitted to the NICU during the same time period. That quotient was used to determine which term infants in the birth log were selected. For example, if 100 infants were born and 10 infants were admitted to the NICU, then every tenth term infant was selected.

Evaluation Procedure

Each participant received a phone call and/or a follow-up letter to inform them of the evaluation procedures, the purpose of the study and the appointment date and time. Upon arrival at the Pediatric Clinic the expanded procedure protocol was explained to the mother and a written informed consent was obtained. The mother was introduced to one of three child life workers who administered the TACL and VMI to the child and conducted the Behavioral Interview with the mother. Next, the mother and child entered the developmental evaluation center which was set up as a play-room. The child was told she/he and her/his mother could play with any of the available toys (step and slide, book, ball, puzzle, paper, scissors, magic markers, puppet, and mechanic's bench). The mother was asked to play with her child as if they were at home (see Appendix I). It was hoped that this free play period would help the child feel at ease. The play time was videotaped for five minutes and played back for the mother and child to see. The use of mother/child interaction as an independent variable is beyond the scope of this study. These data will be analyzed in a separate study. After the free play period the Stanford-Binet was administered to the child with the mother present. The Personal Interview and the Stressful Life Events check list was conducted with the mother. Finally, the child was taken to the clinic to be weighed and measured. Mothers were informed of the test results and suggestions were given for appropriate developmental activities to do at home. Each child left with a picture of him/herself and a book.

Data Analysis

The data was analyzed by a series of multivariate multiple regression procedures. For the first question regarding the regression slopes, the independent variables were material resources, mother's age, stressful life events, social environment, birth weight, intrapartum factors, and neonatal factors. The dependent variables were IQ, language comprehension, visual-motor integration, and behavior.

For the second question each dependent variable (IQ, language comprehension, visual-motor integration, behavior and somatic measurements) was regressed on variables representing high risk and term groups, race of the baby, material resources, mother's age, stressful life events, social environment, birthweight, intrapartum factors, neonatal factors as well as product terms appropriate for implementing the hypothesized interactions.

The independent variables for question three were the same as they were for the first question except for the addition of the birth weight by neonatal factor interaction. The dependent variables for this question were IQ, language comprehension, behavior, visual-motor integration and somatic measurements.

For question four the regression weight for each independent variable (same ones as for the first three questions) and sqared partial correlations were listed in order of the strength of the relationship to the dependent variables (IQ, language comprehension, visual-motor integration and behavior).

For question five, a set of univariate multiple regression equations were computed to evaluate the predictive function of birth weight, neonatal factors, and birth weight by neonatal factor interaction.

For question six the multivariate analysis tested for the predictive contributions of four additional independent variables (mother's age, stressful life events, social environment, and material resources) when the birth conditions were controlled for.

This chapter has described the research design of the study. The next chapter will provide the results of the multivariate multiple regression analysis.

CHAPTER IV

RESULTS

A multiphasic battery was used for the purpose of measuring varaiables which describe the developmental status of high risk infants at age three. The two main questions of concern were: 1) Do those infants who were small and/or sick at birth catch up in their developmental status to term infants? and 2) Which of the variables under investigation contribute the most to the prediction of the developmental status of three year olds. To answer these questions, the specific questions posed in Chapter I will be analyzed. The results of the multivariate multiple regression analyses of the data are presented in this chapter. Table 3 explains the symbols and abbreviations used in the analysis of the data. Appendices J-Q provide descriptive data for the two groups.

Question One: Homogeneity of Regression

The first question posed for this study was: Are the slopes of the regression lines for each dependent variable (IQ, LC, VMI, and BEH) on each predictor variable (MR, M'AGE, SLE, SE, BW, IF, and NF) equal for the High Risk and the Term groups? Multivariate multiple regression procedures were used to test the hypothesis that the regression slopes were equal for both groups. No significant differences were found between the slopes of the two groups (see Table 4).

Table 3

Abbreviations Used in This Chapter

Abbreviation	Variable Name
IQ	Intelligence Quotient
LC	Language comprehension
VMI	Visual-motor integration
HT	Height at three years
WT	Weight at three years
HC	Head circumference at three years
BEH	Mother's perception of child's behavior
MR	Material resources (SES)
M'AGE	Mother's age
SLE	Stressful Life Events
SE	Social Environment
BW	Birth weight
IF	Intrapartum factors
NF	Neonatal factors
BW*NF	Birth weight by Neonatal Interaction

Table 4

Multivariate Test of Equal Regression Slopes (Dependent Variables: IQ, LC, VMI, and BEH)

Independent Variable	F*	P
Material Resources	0.99	0.4158
Mother's Age	0.18	0.9497
Stressful Life Events	0.26	0.0931
Social Environment	1.27	0.2905
Birth Weight	1.00	0.4146
Intrapartum Factors	0.16	0.9598
Neonatal Factors	1.82	0.1337
Birth weight by Neonatal Factors	1.56	0.1924

* Exact transformation of Wilks' Criterion to an F statistic.

Question Two: Significance of Interaction Terms

The second question for this study was: Are there any significant interactions between birth weight and intrapartum factors, birth weight and material resources, and birth weight and neonatal factors? Each dependent variable was regressed on variables representing High Risk and Term groups, race of the baby, MR, M'AGE, SLE, SE, BW, IF, NF as well as product terms appropriate for implementing the hypothesized interactions. The F statistic tested the hypotheseis that there were no significant interations. The multivariate tests indicated that the birth weight by neonatal factors was the only interaction that significantly contributed to the prediction of at least one of the dependent variables (see Table 5). The univariate analysis suggested that the birth weight by neonatal factors interaction contributes to the prediction of IQ, VMI and BEH but not to the prediction of LC (see Table 6). Since this is a follow-up to the multivariate test the conventional alpha level of .05 needs to be reduced somewhat. Therefore alpha level for the univariate tests was set at .0125.

Question Three: Differences Between Groups

The third question for analysis was: Do infants who were NICU graduates differ significantly from term infants with respect to IQ, language comprehension, behavior, visual-motor integration or somatic measurements at age three? A multivariate multiple regression procedure was used to regress each dependent variable on variables representing group, race, MR, M'AGE, SLE, SE, BW, IF, NF, and BW*NF. An F statistic was obtained from the transformation of the Wilks' Criterion to test the hypothesis of no significant difference between the High Risk and the Term groups ($F = 1.70$, $p = 0.1185$).

Table 5

Multivariate Tests for Significant Interactions (Dependent Variables: IQ, LC, VMI, and BEH)

Interaction Term	F*	P
Material Resources by Birth Weight	0.19	0.9408
Birth weight by Intrapartum Factors	1.38	0.2486
Birth weight by Neonatal Factors	4.83	0.0015

* Exact transformation of Wilks' Criterion to an F statistic.

Table 6

Univariate Test for Significant Birth Weight by Neonatal Factors Interaction

Dependent Variable	Birth Weight by Neonatal Factor Interaction F	P
IQ	6.96	0.0097
LC	4.16	0.0443
VMI	14.22	0.0003
BEH	6.92	0.0100

In addition to the multivariate test for difference between groups it was decided to do t-tests for group differences with respect to IQ, language comprehension, and visual-motor integration when no other variables are controlled. Appendix J gives the means and standard deviations by groups for IQ, language comprehension, and visual-motor integration. The results of the one-way ANOVA indicated no significant differences between the mean scores on IQ, LC, and VMI for NICU graduates and term children (see Table 7).

Question Four: Unique Contributions of the Independent Variables

The fourth question for this study was: Which of the independent variables (material resources, mother's age, stressful life events, social environment, birth weight, intrapartum factors, neonatal factors, and birth weight by neonatal factors interaction) have the strongest linear relationship with IQ, language comprehension, visual-motor integration and behavior when the other independent variables are partialed out? The independent variables, their regression weights and the squared partial correlations are listed in order of the strength of the relationships in Tables 8 - 11.

Material resources, birth weight and birth weight by neonatal factor interaction had the strongest relationship with IQ and language comprehension. Birth weight by neonatal factor interaction, birth weight, material resources and mother's age were the significant contributors to the prediction of visual-motor integration. Stressful life events and birth weight by neonatal factor interaction had the strongest relationship to mother's perception of the child's behavior.

Table 7

t Values From One-Way Anovas to Test for Difference Between Groups

Dependent Variable	t	P
IQ	1.384	0.1695
Language Comprehension	0.000	0.9978
Visual-Motor Integration	1.015	0.3126

Table 8

Regression Weights and Squared Partial Correlations for IQ
(R^2 for Full Model was .457)

Independent Variable	Regression Weight	Squared Partial Correlation	P*
Material Resources	-2.02872996	0.111	0.0011
Birth Weight	0.01100188	0.099	0.0020
Birth Weight by Neonatal Factor Interaction	-0.00030643	0.094	0.0028
Neonatal Factor	0.32843700	0.015	0.2467
Stressful Life Events	0.29603046	0.014	0.2516
Social Environment	-0.15609795	0.002	0.6767
Intrapartum Factors	-0.05607739	0.001	0.7760
Mother's Age	-0.01255686	0.000	0.9712

*P value for testing the hypothesis that the corresponding partial correlation is zero.

Table 9

Regression Weight and Squared Partial Correlations for Language Comprehension
(R^2 for Full Model was .319)

Independent Variable	Regression Weight	Squared Partial Correlations	P*
Birth Weight	0.01360901	0.072	0.0094
Birth Weight by Neonatal Factor Interaction	-0.00033577	0.054	0.0252
Material Resources	-1.81745656	0.044	0.0443
Neonatal Factors	-0.27706759	0.005	0.5070
Social Environment	-0.31787679	0.004	0.5665
Intrapartum Factors	-0.14497846	0.003	0.6195
Mother's Age	0.16588886	0.001	0.7476
Stressful Live Events	0.09854570	0.001	0.7959

*P value for testing the hypothesis that the corresponding partial correlation is zero.

Table 10

Regression Weights and Squared Partial Correlations for Visual-Motor Integration
(R^2 for Full Model was .463)

Independent Variable	Regression Weight	Squared Partial Correlation	P*
Birth Weight by Neonatal Factors Interaction	-0.00031407	0.158	0.0001
Birth Weight	0.00835025	0.099	0.0021
Material Resources	-1.19899290	0.070	0.0104
Mother's Age	-0.61499223	0.056	0.0222
Intrapartum Factors	0.30865272	0.045	0.0420
Neonatal Factors	0.39766008	0.036	0.0671
Stressful Life Events	-0.27554180	0.021	0.1620
Social Environment	-0.04388678	0.000	0.8777

*P value for testing the hypothesis that the corresponding partial correlation is zero.

Table 11

Regression Weights and Squared Partial Correlations for Behavior
(R^2 for Full Model was .185)

Independent Variable	Regression Weight	Squared Partial Correlation	P*
Stressful Life Events	0.15950455	0.094	0.0026
Birth Weight by Neonatal Factor Interaction	0.00005059	0.066	0.0131
Birth Weight	-0.00133489	0.039	0.0579
Neonatal Factors	-0.10014986	0.033	0.0797
Mother's Age	-0.10838053	0.026	0.1230
Material Resources	-0.07953357	0.005	0.5117
Social Environment	-0.02058085	0.001	0.7840
Intrapartum Factors	0.00010949	0.000	0.9857

*P value for testing hypothesis that the corresponding partial correlation is zero.

Question Five: Birth Weight and Neonatal Complications

The fifth question for this study was: Do IQ, language comprehension, visual-motor integration and somatic measurements (height, weight, and head circumference) vary as a function of birth weight, neonatal factors, or birthweight by neonatal factor interaction? A set of univariate multiple regression equations was computed to evaluate the predictive function of these three independent variables. The combined variables of birth weight neonatal factors, and birth weight by neonatal factor interaction do predict IQ, visual-motor integration, height, weight, and head circumference. The data indicated no significant relationship between the above three independent variables and language comprehension or behavior (see Table 12). Due to the problem of multicolinearity of the birth weight and neonatal factors (r = -.41),it is difficult to separate the strength of the relationship between each individual birth variable and the dependent variables. However, the data suggest that birth weight had a significant relationship to the somatic measurements at age three. Neonatal factors alone seem to have no significant relationship to the dependent variables. The birth weight by neonatal factor interaction appears to relate significantly to visual-motor integration and head circumference. The data also suggest that the interaction may also have a significant relationship to IQ (see Table 13).

Question Six: Test of Additional Variables

The last question asked in this study was: When controlling for birth weight, intrapartum factors, and neonatal factors, do mother's age, material resources, social environment and/or stressful life events add to the prediction of IQ, language comprehension,

Table 12

Predictive Contributions of Combined Birth Variables

Dependent Variable	Birth Weight, Neonatal Factors and Interaction		
	F	R^2	P*
IQ	6.11	.158	.0008
Language Comprehension	2.50	.071	.0630
Visual-Motor Integration	8.37	.204	.0001
Height	5.73	.149	.0013
Weight	7.13	.179	.0003
Head Circumference	5.90	.153	.0011
Behavior	1.61	.047	.1894

*P value for testing the hypothesis that the R^2 is equal to zero.

Table 13

Predictive Contribution of Birth Weight, Neonatal Factors and Birth Weight by Neonatal Factor Interaction

Dependent Variable	Birth Weight			Neonatal Factors			Birth Weight by Neonatal Factor Interaction		
	T	r^{2*}	P**	T	r^2	P*	T	r^2	P*
IQ	2.03	.040	.0446	0.58	.003	.5652	-2.01	.039	.0475
Visual-Motor Integration	1.15	.013	.2513	0.84	.007	.4018	-2.81	.075	.0059
Height	3.05	.087	.0029	0.51	.003	.6092	-0.66	.004	.5116
Weight	3.31	.101	.0013	0.53	.003	.5993	-0.96	.009	.3379
Head Circumference	2.99	.084	.0035	1.65	.027	.1016	-2.71	.070	.0079

*squared partial correlation

**P value for testing the hypotheses that the corresponding squared partial is zero.

visual-motor integration and behavior? The F statistics in Table 14 are used to test whether any one of the regression coefficients for the four additional variables are equal to zero. These statistics indicate that at least one of the additional independent variables contributes to the prediction of IQ, visual-motor integration and behavior. The data further suggest that none of the additional variables contribute to the prediction of language comprehension. Follow-up tests were used to indicate which of the additional variables contributed to the prediction of IQ and visual-motor integration and behavior. The F statistics in Table 15 are used to test whether the regression coefficient for each of the additional variables is equal to zero. It was found that material resources contributed significantly to the prediction of IQ and visual-motor integration but not to behavior. Mother's age did not add predictive value to any of the dependent variables. The amount of stressful life events occuring in the mother's life has predictive value for the mother's perception of her child's behavior. The condition of the mother's social environment did not contribute to the prediction of any of the dependent variables.

In summary, there were no statistically significant differences between the NICU and NBN groups. The data do suggest, however, that the small infants are still small at three years of age and the infants who had the greatest amount of complications tended to have lower IQs and poorer scores on visual-motor integration. In general, the best predictors of three year developmental status were birth weight, material resources and birth weight by neonatal interaction. Discussion and implications of these results are presented in Chapter V.

Table 14

Test for Significant Contribution of Combined Additional Independent Variables (Independent Variables: Mother's Age, Material Resources, Stressful Life Events and Social Environment)

Dependent Variable	F	P
IQ	4.50	0.0023
Language Comprehension	2.23	0.0723
Visual-Motor Integration	3.39	0.0124
Behavior	3.16	0.0175

Table 15

Test of Additional Variables

Additional Variable	IQ		VMI		BEH	
	F	P	F	P	F	P
Material Resources	11.50	.0010	6.78	.0108	0.37	.5467
Mother's Age	0.00	.9713	5.46	.0216	2.60	.1104
Stressful Life Events	0.99	.3212	2.09	.1522	7.69	.0067
Social Environment	0.15	.6998	0.01	.9252	0.00	.9736

CHAPTER V

DISCUSSION

The purpose of this study was to describe the three year developmental status of infants who were placed in the Neonatal Intensive Care Unit (NICU). Infants who were premature or sick at birth were placed in the NICU where they received the benefit of special equipment and individualized attention from the specialized neonatal staff. The developmental status of 51 NICU graduates and 51 term infants (the comparison group) was evaluated with a multiphasic battery of tests. All children were between the ages of 36 and 42 months at the time of testing. There were two major questions that this study attempted to answer. One, do those infants who were sick and/or premature at birth (the High Risk group) catch up in their development to term infants? Two, which of the variables under investigation contribute the most to the prediction of developmental status?

Major Findings

The data indicated there were no significant differences between the two groups on any of the measures of intelligence, language, visual-motor integration and behavior. The developmental status of the high risk (NICU) group was statistically equal to that of the comparison group of term infants. The results indicated that, even though these children began life with medical complications, they are developing as well as their peers at three years of age.

The birth condition variables (birth weight, neonatal factors, and birth weight by neonatal factor interaction) had a significant relationship to IQ, visual-motor integration and the somatic measurements, but not to language comprehension or the mother's perception of her child's behavior. Low birth weight infants tend to be smaller than term infants at age three. The birth weight by neonatal factor interaction had a significant relationship to visual-motor integration and IQ. This suggests that an infant who was small and sick is likely to have lower visual-motor and IQ scores.

Two of the socioenvironmental variables (material resources and stressful life events) added to the prediction of developmental status. Material resources (socioeconomic status) contributed significantly to the prediction of IQ and visual-motor integration. Families with less material resources had children with lower IQ and visual-motor scores.

The amount of stressful life events in a mother's life had a significant relationship to her perception of her child's behavior. The data indicated that the mothers who experience a greater amount of negative changes in their lives perceived their child as having more behavioral problems.

The results of this study suggest that the three variables which contribute the most to the prediction of developmental status are birth weight, the family's material resources, and birth weight by neonatal factor interaction. Of most significance, perhaps, is the finding that a large porportion of variance in the developmental status of three year olds remains unexplained. The combined contributions of the variables investigated in this study are not able to predict three year developmental status with an appreciable amount of precision.

Implications

The regression model used in this study explained only 30 to 45 percent of the variance for IQ, language comprehension, and visual-motor integration. A large proportion of the variance of developmental status remained unexplained by the data. Therefore, there is a need to develop a more precise model in order to identify those children who are at risk for developmental and educational delay. This leads to several questions regarding additional sources of variance in development. One area of interest for future research efforts would be the investigation of the behavioral manifestations of maternal perception; specifically, the documentation of the repertoire of behaviors included in the mother-child transaction process. Other research concerned with the developmental outcomes of high risk infants has noted the mother-child relationship to be of importance to the child's development of competence.

There were no statistically significant differences between the two groups, but the fact that the High Risk group exhibited consistently lower scores suggests a need for long term follow up of these children as they enter preschool and primary education programs. It was also noted that five children in the NICU group were visually impaired. None of the comparison group appeared to have any visual impairment. We have reason to suspect that these developmental differences at three years may manifest themselves in the ability of the young child to learn. In view of this, a multiphasic assessment of these children throughout early childhood would assist in the early identification of learning competencies. Should delays be identified, the assessment would provide detailed diagnostic information regarding possible avenues for prescriptive intervention.

Summary

The study suggests that infants who were premature or sick at birth do as well developmentally at age three as infants who had no complications at birth. Identifying the conditions which precipitate developmental delays in children remains a challenge to educators and researchers. It is the responsibility of the professional community to design and implement programs of identification, prevention and intervention for high risk infants with developmental delays.

APPENDIX A

HIGH-RISK SCREENING* INTRAPARTUM FACTORS

I. MATERNAL FACTORS

1. Moderate-severe toxemia (preeclampsia)	10	11. Second stage > 2-1/2 hours	5
2. Hydramnios/oligohydramnios	10	12. Labor > 20 hours	5
3. Amnionitis	10	13. Clinical small pelvis	5
4. Uterine rupture	10	14. Medical induction	5
5. Mild toxemia	5	15. Preciptitous labor > 3 hours	5
6. PROM > 12 hours	5		
7. Primary dysfunctional labor	5	16. Primary cesarean section	5
8. Secondary arrest of dilation	5	17. Repeat cesarean section	5
9. Demorol > 300 mg.	5	18. Elective induction	1
10. MgSo4 > 25 gm.	5	19. Prolonged latent phase	1
		20. Uterine tetany	1
		21. Pitocin augmentation	1

II. PLACENTAL FACTORS

1. Placenta previa	10	5. Meconium stained amniotic fluid (dark)	5
2. Abruptio plancentae	10	6. Marginal separation	1
3. Postterm 42 weeks	10		
4. Meconium stained amniotic fluid (dark)	10		

---

*Hobel, 1973

III. FETAL FACTORS

1. Abnormal presentation	10	8. Fetal tachycardia > 30 min.	10
2. Multiple Pregnancy	10	9. Operative forceps or vacuum extraction	5
3. Fetal bradycardia ≥ 30 min.	10	10. Breech delivery spontaneous or assisted	5
4. Breech delivery total extraction	10	11. General anesthesia	5
5. Prolapsed cord	10	12. Outlet forceps	1
6. Fetal weight < 2500 gms.	10	13. Shoulder dystocia	1
7. Fetal acidosis pH ≤ 7.25	10	14. Fetal distress	10

APPENDIX B

HIGH RISK SCREENING*
NEONATAL FACTORS

I. GENERAL

1. < 1000 gms.	15	7. Dysmaturity	5
2. Apgar 5m = < 5	10	8. Apgar 1m = < 5	5
3. Resuscitation	10	9. Feeding problem	1
4. 1000-1500 gms.	10	10. Multiple birth	1
5. Fetal Anomalies	10	11. 2000-2500 gms.	1
6. 1500-2000 gms.	5		

II. RESPIRATORY

1. RDS	10	4. Anomalies of respiratory systems	10
2. Meconium aspiration	10	5. Apnea	10
3. Congenital pneumonia	10	6. Transient tachypnea	5

III. METABOLIC DISORDERS

1. Hypoglycemia	10	4. Hypoparathyroidism	5
2. Hypocalcemia	10	5. Failure to gain weight	1
3. Hypo/hypermagnesemia	5	6. Jitteriness	1

*Hobel, 1973

IV. CARDIAC

1. Major cardiac anomalies with catheterization	10	4. Major cardiac anomalies with catheterization	5
2. CHF	10	5. Murmur	5
3. Persistent cyanosis	5		

V. HEMATOLOGIC PROBLEMS

1. Hyperbilirubinemia, > 15	10	3. Chromosomal anomolies	10
2. Hemorrhagic diathesis	10	4. Sepsis	10
		5. Anemia	5

VI. CNS

1. CNS depression > 24 hours	10	3. CNS depression < 24 hours	5
2. Seizures	10		

APPENDIX C

PERSONAL INTERVIEW*

Hosp. # _ _ / _ _ / _ _ Name____________________________________

____

Part A:

1. What is your full name ________________________ 1.

2. DOB _ _ / _ _ / _ _ Weight _ _ _ Height _ft. _ins. 2.

3. What is your present address? ______________________ 3.
street

_________________________ ______________________
county city

**4. What was the last grade you completed in school? 4.

**5. Are you working now? 1 = yes 2 = no 5.

**6. If yes: a. What do you do? 6. a.
- 1 = professional
- 2 = technical, skilled labor, clerical
- 3 = unskilled labor, unemployed

b. How many hours a week do you work? ________ b.

c. Who takes care of your child while at work? c.
- 1 = husband
- 2 = other relative
- 3 = friend, neighbor, babysitter
- 4 = day care or nursery school

d. How long has your child been with a babysitter or in day care? d.
- 1 = 3 months
- 2 = 3-6 months
- 3 = 6-12 months
- 4 = 12-18 months
- 5 = 18-24 months
- 6 = 24 months

---

*Modification of Kotlechuck (Grossman, 1979)
**Items used to obtain the Material Resources Score.

**7. What is your marital status? 1 = married 7.
2 = single
3 = divorced
4 = separated
5 = widowed

8. If married or separated: 8.

a. How long have you been married? ___yrs. ___mos. a.
b. Is this your first marriage? 1 = yes 2 = no b.
c. Is he ________'s father? 1 = yes 2 = no c.

Part B:

9. What is ________'s father's name ____________? 9.

10. DOB __ / __ / __ 10.

11. What was the last grade in school he completed? ____ 11.

12. Is he working now? What does he do? 12.

1 = professional
2 = technical, skilled labor, clerical
3 = unskilled labor, unemployed

Part C:

**13. Do you live in a: 1 = house 13.
2 = trailer
3 = apartment

**14. Do you own or rent? 1 = own 2 = rent 14.

15. How long have you lived there? ___yrs. ___mos. 15.

***16. If less than one year, how many times have you moved in the past year? __________ 16.

17. For regular health care, do you take your child to a: 17.

1 = private physician
2 = county health department
2 = emergency room
4 = outpatient clinic
5 = other

**Items used to obtain the Material Resources Score.
***Items used to obtain the Social Environment Score.

18. What city? ____________ County? ___________ 18.

***19. Has your child been hospitalized since birth? 19.

1 = yes 2 = no

***20. How many times? 20.

Age	Reason	How Long	Where

**21. What is your yearly family income? 21.

1 = 0 - $4,000
2 = $4,001 - $6,000
3 = $6,001 - $8,000
4 = 8,001 - $12,000
5 = $12,000 or more

22. How many people are supported on this income? _____ 22.

Part D:

***23. Do you own or have access to a car? 23.

1 = yes 2 = no

***24. Do you have a telephone? If yes, what's the #? 24.

1 = yes 2 = no ___-___-____

***25. Would you say its generally easy or difficult for you to get to: 25.

25. Shopping
26. Work
27. Recreation

1 = very difficult 26.
2 = somewhat difficult
3 = depends 27.
4 = somewhat easy
5 = very easy

***28. How many relatives live around your area? (adults) ___ 28.

***29. How many of these can you count on in times of real need? _____ 29.

***30. How many people (friends or relatives) would be able to help you in taking care of your children for a couple of hours if there was a need? _______ 30.

**Items used to obtain the Material Resources Score.
***Items used to obtain the Social Environment Score.

***31. Do you get together with relatives or friends often? 31.

1 = yes 2 = no

***32. How many times a week? 32.

1 = never, no relatives
2 = rarely-up to once every few months
3 = sometimes-a few times a month to once a week
4 = often-a few times a week
5 = very frequently-every day

***33. Do you belong to any organizations such as: social, religious, educational, or political groups? Which ones? ______________________ 33.

Part E:

***34. Do you or anyone in your household drink? If yes, how many drinks per week do you or that person consume? 34.

1 = no
2 = minor
3 = moderate
4 = severe

***35. Are drugs occasionally used in your household? If so, which ones and how often? 35.

1 = never
2 = seldom
3 = sometimes
4 = frequently

***36. Does your present situation provide you with enough or not enough of the emotional support you want? 36.

1 = enough
2 = sometimes, sort of
3 = not enough
4 = not at all

***37. Do you feel you're overwhelmed with household tasks and children? How often do you feel this way? 37.

1 = never
2 = infrequently
3 = sometimes
4 = often
5 = all the time

***Items used to obtain the Social Environment Score.

***38. How many times a month do you get away by yourself to do something you would like to do? __________ 38.

***39. Do you think this is enough time? 39.

1 = not enough
2 = enough
3 = too much

***40. On the whole, would you describe your present living situation as happy or unhappy? 40.

1 = very unhappy
2 = somewhat unhappy
3 = neutral
4 = somewhat happy
5 = very happy

***41. In general, do you and your husband (mother, boyfriend) usually agree about how to discipline your child? 41.

1 = no
2 = sort of
3 = sometimes
4 = yes

***42. Do you and your husband (or boyfriend) ever disagree violently with each other? How often does this occur? 42.

1 = no
2 = infrequently
3 = sometimes
4 = often
5 = all the time

***43. If yes, does this ever lead to hitting or throwing things at each other? How often does this occur? 43.

1 = no
2 = infrequently
3 = sometimes
4 = often
5 = all the time

***Items used to obtain the Social Environment Score.

APPENDIX D

STRESSFUL LIFE EVENTS*

This is a list of things that happen that can cause a change in people's lives. Each change may cause a certain amoint of stress or anxiety. Put an X in the square beside each event that has happened to you or someone close to you within the past 12 months. Then circle 1, 2, 3, or 4 beside each event that has an X.

1 = not stressful
2 = mildly stressful
3 = moderately stressful
4 = very stressful

1.	Getting married	___	1	2	3	4	1. ___
2.	Being kept in jail	___	1	2	3	4	2. ___
3.	Having trouble with the boss	___	1	2	3	4	3. ___
4.	Husband dies	___	1	2	3	4	4. ___
5.	Greater difficulty getting to sleep	___	1	2	3	4	5. ___
6.	A close family member dies	___	1	2	3	4	6. ___
7.	Loss of appetite	___	1	2	3	4	7. ___
8.	Foreclosure on a mortgage or loan	___	1	2	3	4	8. ___
9.	A close friend dies	___	1	2	3	4	9. ___
10.	Getting in trouble with the law	___	1	2	3	4	10. ___
11.	Becoming pregnant	___	1	2	3	4	11. ___
12.	A family member gets very sick	___	1	2	3	4	12. ___
13.	Sexual difficulties	___	1	2	3	4	13. ___

---

*Adapted from Holmes and Wrath, Schedule of Recent Events.

14.	Trouble with in-laws	___	1	2	3	4	14. ___
15.	Fewer family get togethers	___	1	2	3	4	15. ___
16.	Big reduction in income	___	1	2	3	4	16. ___
17.	Moving to a different house	___	1	2	3	4	17. ___
18.	Splitting up with your husband	___	1	2	3	4	18. ___
19.	Being fired from work	___	1	2	3	4	19. ___
20.	Getting divorced	___	1	2	3	4	20. ___
21.	Changing to a worse job	___	1	2	3	4	21. ___
22.	More arguments with husband or boyfriend	___	1	2	3	4	22. ___
23.	Having a bad accident or illness	___	1	2	3	4	23. ___
24.	Having fewer social activities	___	1	2	3	4	24. ___
25.	Living conditions get worse	___	1	2	3	4	25. ___
26.	Dropping out of school	___	1	2	3	4	26. ___

APPENDIX E

STANFORD-BINET INTELLIGENCE SCALE
FORM L-M

Year II

___1. Form board
___2. Delayed response
___3. Parts of body
___4. Block tower
___5. Picture vocabulary
___6. Word combinations
___A. Ident. Obj. by name

Year II-6

___1. Ident. obj. by use
___2. Parts of body
___3. Naming obj.
___4. Picture vocabulary
___5. 2 digits
___6. Simple commands
___A. Form board: rot.

Year III

___1. Stringing beads
___2. Picture vocabulary
___3. Block bridge
___4. Picture memories
___5. Copying circle
___6. Vertical line
___A. 3 digits

Year III-6

___1. Comp. balls
___2. Patience: pictures
___3. Discr. animal pictures
___4. Response to pictures
___5. Sorting buttons
___6. Comprehension
___A. Comp. sticks

Year IV

___1. Picture vocabulary
___2. Obj. from memory
___3. Opp. analogies
___4. Pict. ident.
___5. Discr. forms
___6. Comprehension II
___A. Sent. mem. I

Year IV-6

___1. Aesth. comp.
___2. Opp. analogies
___3. Pict. sim. & diff.
___4. Materials
___5. 3 commissions
___6. Comprehension III
___A. Pict. ident.

Year V

___1. Pict compl.: man
___2. Folding triangle
___3. Definitions
___4. Copying square
___5. Pict. sim. & dif. II
___6. Patience: rectangles
___A. Knot

Year VI

___1. Vocabulary
___2. Differences
___3. Mut. pictures
___4. Number concepts
___5. Opp. analogies II
___6. Maze
___A. Response to pictures

Year VII

___1. Pict. absurd. I
___2. Simil.: 2
___3. Copying diamond
___4. Comprehension IV
___5. Opp. analogies III
___6. 5 digits
___A. 3 dig. rev.

Year VIII

___1. Vocabulary
___2. Wet Fall
___3. Verb. absurd. I
___4. Sim. & dif.
___5. Comprehension IV
___6. Days of week
___A. Prob. sit. I

APPENDIX F

TEST FOR AUDITORY COMPREHENSION OF LANGUAGE*

Item No.	Child's Response	Correct Response	
1		2	Bicycle
2		2	Bird
3		1	Girl
4		3	Cat
5		2	Farm
6		3	Sheep
7		1	Hand
8		1	Man
9		3	Paint
10		2	Pair
11		1	Red
12		3	Black
13		1	Yellow
14		2	Big
15		1	Fast
16		3	Little
17		1	Soft
18		2	Tall
19		3	Show me the two that are alike.
20		1	These two are different.
21		1	Two
22		3	Some
23		3	Many
24		2	Find the middle car.
25		3	More
26		3	Four
27		1	A Few
28		2	Second
29		1	Half
30		1	Here is a star. Now point to the bottle.
31		3	Eating
32		3	Jump
33		1	Running
34		2	Coming
35		3	Going
36		2	Hitting
37		1	Catching
38		1	Giving
39		2	Up
40		3	Easily

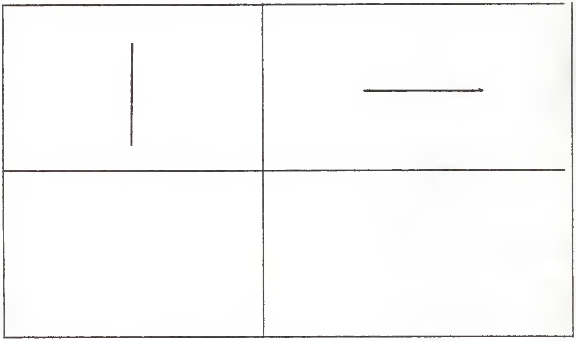
*Carrow, 1973.

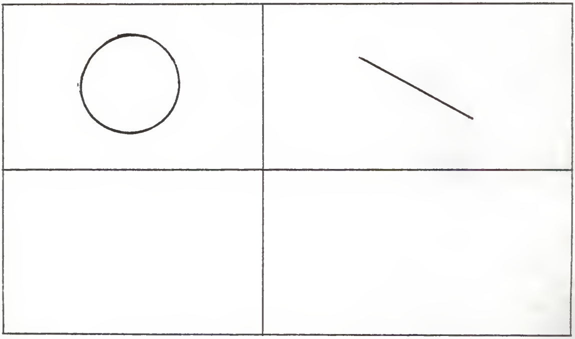
Item No.	Child's Response	Correct Response	
41	________	1	Gently
42	________	2	That
43	________	2	These
44	________	1	On the table.
45	________	3	Under the table.
46	________	2	In the box.
47	________	1	The boy is at the side of the car.
48	________	2	The cat is between the cars.
49	________	1	The dog is in front of the car.
50	________	1	Farmer
51	________	3	Painter
52	________	2	Hitter
53	________	3	Fisherman
54	________	2	Smaller
55	________	1	Taller
56	________	2	Fattest
57	________	1	Bicyclist
58	________	1	Pianist
59	________	2	They
60	________	1	He
61	________	3	She
62	________	3	Mother gave the ball to her.
63	________	1	His puppy is black and white.
64	________	1	She is going shopping.
65	________	2	We're eating apples.
66	________	1	Chairs
67	________	3	Balls
68	________	1	Coats.
69	________	2	Table
70	________	1	The sheep is eating.
71	________	3	The fish are eating.
72	________	2	The girl is sewing.
73	________	2	The girl is jumping.
74	________	3	The man painted the house.
75	________	3	The lion has eaten.
76	________	1	He will hit the ball.
77	________	3	The man has been cutting trees.
78	________	1	The boy pushes the girl.
79	________	2	The car bumps the train.
80	________	1	The donkey is carried by the man.
81	________	1	The boy is chased by the dog.
82	________	3	Who is by the table?
83	________	2	When do you sleep?
84	________	3	What do we eat?
85	________	2	The girl is drawing.
86	________	2	It's not black.
87	________	1	The girl isn't running.
88	________	3	Neither the boy nor the girl is jumping.
89	________	1	Go!
90	________	2	Don't cross!
91	________	1	Sleeps
92	________	1	Has ice cream.

Item No.	Child's Response	Correct Response	
93	________	3	Find the car that is on the street.
94	________	2	Find the cat with no eyes.
95	________	1	She shows the girl the boy.
96	________	3	A large blue ball.
97	________	3	A small red car.
98	________	1	The girl is not swimming.
99	________	2	If you're the teacher, point to the dog; if not, point to the bear.
100	________	2	Find the one that is neither the ball nor the table.
101	________	1	Look at the third picture, then point to the baby of this animal.

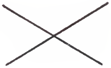
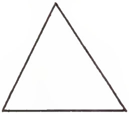
APPENDIX G

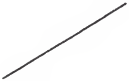
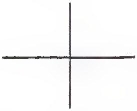
DEVELOPMENTAL TEST OF VISUAL-MOTOR INTEGRATION*





*Beery, 1967.

APPENDIX H

BEHAVIORAL INTERVIEW*

We're trying to find out how 3 year olds develop and behave and we're asking parents to help us with their experience. I'd like to ask you a few questions about how your child is getting along.

1. Have there been any eating problems in the past few weeks like a very poor appetite? Doex X eat everything or is s/he fussy? Poor appetite 1. ______

2. How often do you feel X isn't eating enough . . . or isn't getting the right food? Faddy eater 2. ______

   0 = No eating problems (include here the occasional missed meal or fad)
   1 = Some eating difficulties (has a few fads, or has a poor appetite for one meal a day or less)
   2.= Marked difficulties (appetite poor for at least half the meals: diet mainly milk and/or baby foods or sweets and biscuits, or eats only a few articles of food or refused practically all meat and/or vegetables)

3. Some children eat or drink unusual things which aren't food. Does X ever do this? Things like paper, coal, toys, dirt. How often in the past few weeks? Things eaten: 3. ______

   Do not include things that are sucked like buttons; objects must be definitely chewed, eaten or drunk.

   0 = Never eats or drinks things not food
   1 = Sometimes eats things not food--twice a week or less
   2 = Frequently eats things not food--three times a week or more

4. Does X ever soil his/her pants at night or during the day? How often? 4. ______

   0 = None
   1 = Twice a week or less
   2 = Three times a week or more

*Adapted from Richman and Graham, 1971.

5. A lot of children don't like going to bed. What about X? What about going to sleep? 5. ______

6. Does s/he sleep right through the night? If not, what happens? How often does this happen? How long does it last? 6. ______

0 = No problem or problems less than once a week
1 = Problem occurs 1-2 times a week only
2 = Problem occurs 3 times a week or more and either takes more than 1 hour to get to sleep, or wakes more than a few minutes, or goes into parents' room or bed

7. Does X have any habits before going to sleep or during the day? Such as: 7. ______

headbanging
rocking
nervous movements like blinking, pulling faces, grinding teeth
picking, pulling, scratching hair, skin, or nails
sucking thumb or fingers
sucking other objects
biting nails
other (describe)

0 = No habits
1 = 1-3 habits sometimes or 1 frequent habit
2 = 2 or more frequent habits, or 4 or more habits altogether

8. What is X saying now? Does s/he put words together? 8. ______

0 = Phrases of 3 or more words
1 = Single words
2 = No recognizable words

9. How active is X? Is s/he the sort of child who doesn't like sitting still even for meals? How many minutes will s/he sit at mealtimes usually? 9. ______

0 = Not markedly active
1 = Very active
2 = Hyperactive--sits still for meals or on other occasions usually less than 5 minutes

10. What's the longest time X will usually stick at one thing indoors if interested? 10. ______

0 = Concentrates usually for 15 minutes or more
1 = Concentrates usually for 5-14 minutes or very variable
2 = Concentrates usually never more than a few minutes

11. When playing with sibs or friends, do they squabble much? Does X have any of the following problems? 11. ______

    Starts arguments or quarrels
    Gets teased, bullied, upset
    Seems shy, inhibited
    Ignores others
    Seems jealous
    Other

    0 = Trivial or no difficulties
    1 = Some difficulties: play disrupted or prevented most times but only for short periods
    2 = Marked difficulties: play disrupted or prevented most of the time
    3 = No sib/no opportunity to play with others

12. Is X independent or does s/he cling a lot? Can X be left with people s/he knows? At home does X follow you around all day . . . keep asking for attention . . . ask to have things done which could do for self, e.g., in feeding or dressing? 12. ______

    0 = Reasonable independent for age
    1 = Some dependency: upset if left, takes some time to get overit; sometimes demands undue attention
    2 = Marked dependency. Cannot be left at all, continually demands to be with mother, or continually asking for attention

13. In the past few weeks has X been easy to manage or difficult? Do you ever feel X is out of control or difficult to discipline? How often is this? 13. ______

    0 = Easy to manage and discipline
    1 = Sometimes difficult or out of control or hard to discipline for short periods
    2 = Long or very frequent periods, nearly every day, when difficult to manage or discipline

14. Does X have temper tantrums--shouting, screaming, banging, kicking? How often in the past few weeks? How long do they last? 14. ______

    0 = No tantrums
    1 = Brief tantrums lasting a few minutes, 1 or 2 a day
    2 = Frequent tantrums 3 a day or more, or tantrums lasting more than 15 minutes

15. Is his/her mood usually happy or more often miserable or irritable? 15. ______

0 = Usually happy except for brief periods
1 = Sometimes miserable/irritable/discontented for periods less than 1 hour on most days and/or for longer periods once or twice a week
2 = Frequently miserable/irritable on most days and/or for long periods 3 times a week or more

16. Is X a worrier? . . . gets anxious about something that might happen? What about if X loses something . . . if people are away from home . . . falls, accidents in self or others . . . upsetting stories or TV programs . . . new experiences like holidays, a new teacher, changes in doing things? 16. ______

0 = Never or rarely worried
1 = Some worries for brief periods
2 = Many different worries, or worries over certain things for long periods

17. Most children have some fears. What is X afraid of? What about: 17. ______

dogs
cats
other animals/insects
thunder, loud noises
the dark
strangers
going out
car, bus, train
elevators, escalators
water, the bath
haircut, hairwash
doctors
stories
TV programs
other

0 = Is somewhat afraid of 1 or 2 things or has no fears
1 = Has 1 or 2 marked fears or 3-5 fears altogether
2 = Has 3 or more marked fears or 6 or more fears altogether

APPENDIX I

FREE PLAY INSTRUCTIONS

Five minutes of free play preceded the administration of the Stanford-Binet. The following instructions were given to the child:

> You may play with any of the toys on the table, or on the slide, or with the big ball. This is your turn to do what you want to do.

The mother was given the following instructions:

> Most of the activities here today are very structured for your child, so we want to have this time for him/her to do what she/he wants to do. Go ahead and play with your child as if you were at home.

APPENDIX J

MEANS AND STANDARD DEVIATIONS BY GROUP FOR DEPENDENT VARIABLES

	High Risk		Term	
Variable	Mean	SD	Mean	SD
IQ	91	23	97	19
Language Comprehension	102	34	102	21
Visual-Motor Integration	91	19	94	13
Behavior	5.1	3.4	5.5	3.4
Height	95	4.4	96	4.3
Weight	14	2.0	15	1.9
Head Circumference	50	2.7	50	1.9

APPENDIX K

MEANS AND STANDARD DEVIATIONS BY BIRTHWEIGHT FOR DEPENDENT VARIABLES

	< 1000		1001-1500		1501-2000		2001-2500		> 2500	
Variable	M	SD	M	SD	M	SD	M	SD	M	SD
IQ	79	16	90	21	85	17	94	20	98	22
Language Comprehension	84	5	97	33	87	18	102	30	105	29
Visual-Motor Integration	85	4	99	13	85	13	94	18	94	17
Behavior	6.6	1.3	3.9	3.0	4.0	3.9	7.2	4.1	5.3	3.3
Height	91	2.9	93	7.0	95	4.3	97	2.1	97	4.1
Weight	12.2	2.3	13.2	2.4	14.2	1.4	14.4	2.0	15.1	2.0
Head Circumference	48.3	3.1	49.3	2.1	49.6	2.7	50.2	1.4	50.5	2.3

APPENDIX L

FREQUENCY DISTRIBUTION OF SCORES BROKEN DOWN BY GROUPS

	HIGH RISK GROUP				TERM GROUP			
Variable	Delayed*	At Risk**	Within Normal Limits	Above Average	Delayed	At Risk	Within Normal Limits	Above Average
IQ	6	9	32	3	2	12	30	8
Language Comprehension	6	4	30	10	1	5	36	10
Visual-Motor Integration	3	8	34	5	0	11	35	6

*Two standard deviations below the mean

**One standard deviation below the mean

APPENDIX M

FREQUENCY DISTRIBUTION OF IQ SCORES BROKEN DOWN BY BIRTHWEIGHT

Birthweight in Grams	Delayed	At Risk	Within Normal Limits	Above Average
< 1000	1	2	2	0
1001-1500	1	1	6	0
1501-2000	2	2	6	0
2001-2500	1	1	8	1
> 2500	3	15	40	10

APPENDIX N

FREQUENCY DISTRIBUTION OF LANGUAGE COMPREHENSION SCORES BROKEN DOWN BY BIRTHWEIGHT

Birthweight in Grams	Delayed	At Risk	Within Normal Limits	Above Average
< 1000	0	2	3	0
1001-1500	1	2	3	2
1501-2000	3	0	6	1
2001-2500	1	0	9	1
> 2500	2	5	45	16

APPENDIX O

FREQUENCE DISTRIBUTION OF VISUAL-MOTOR INTEGRATION BROKEN DOWN BY BIRTHWEIGHT

Birthweight in Grams	Delayed	At Risk	Within Normal Limits	Above Average
< 1000	0	2	3	0
1001-1500	0	1	6	1
1501-2000	1	5	4	0
2001-2500	1	1	7	2
> 2500	1	10	49	8

APPENDIX P

CORRELATION MATRIX FOR INDEPENDENT AND DEPENDENT VARIABLES

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. IQ	--	.79	.67	.08	.06	.15	-.18	-.50	.14	.05	-.17	.22	.11	-.34
2. LC		--	.60	.12	.13	.29	-.19	-.42	.15	-.01	-.19	.16	.12	-.23
3. VMI			--	.13	.13	.26	-.13	-.37	-.11	-.10	-.14	.05	.09	-.36
4. HT				--	.79	.38	-.06	.13	.11	.05	.02	.38	.06	-.18
5. WT					--	.52	-.08	.20	.05	.01	.10	.40	.04	-.24
6. HC						--	-.22	.03	-.07	-.03	.01	.24	.08	-.26
7. BEH							--	.05	-.17	.30	.10	-.01	.05	-.05
8. MR								--	-.40	.13	.45	-.02	.04	.09
9. MAGE									--	-.14	-.20	.14	.08	.07
10. SLE										--	.40	.03	.03	-.10
11. SE											--	.14	.07	.02
12. BW												--	.12	-.41
13. IP													--	-.11
14. NF														--

APPENDIX Q

MEANS AND STANDARD DEVIATION BY GROUP FOR INDEPENDENT VARIABLES

Independent Variables	High Risk Means	High Risk SD	Term Means	Term SD
Mother's Age	24	6	23	5
Material Resources	14.3	3.7	14.8	4.0
Social Environment	23.1	5.2	24.8	6.0
Stressful Life Events	7.0	7.8	7.4	6.1
Birthweight (in grams)	2238		3216	
Intrapartum Factors	6.7	4.2	6.1	3.9
Neonatal Factors	23.5	4.3	3.4	.8

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Biographical Sketch

June Holstrum was born in Lamoni, Iowa, in 1940. She attended elementary school in Illinois, New York and Connecticut and secondary school in Missouri. In 1964 she received a B.A. in elementary education from the University of Iowa. She taught kindergarten and third grade for three years in a rural Iowa community. From 1969 to 1974 June lived in Austin, Texas, where she obtained certification in early childhood education and taught kindergarten and first grade.

June moved to Gainesville, Florida, in 1974 and taught first grade in the Alachua County Schools for two years. In March, 1976 she entered Graduate School at the University of Florida and was granted a M.Ed. in June, 1977; Ed.S in June; 1978, and Ph.D. in August, 1979.

June is currently employed by the University of Florida, Department of Pediatrics, as an Infant/Toddler Developmental Assessment Specialist. She has three unique, bright, and beautiful daughters: Stacy, 17; Shelly, 16; and Shawn, 13.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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Athol B. Packer, Chairperson
Associate Professor of
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